

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT				1. CONTRACT ID CODE J		PAGE OF PAGES 1 2	
2. AMENDMENT/MODIFICATION NO. P00009		3. EFFECTIVE DATE 11-Feb-2005		4. REQUISITION/PURCHASE REQ. NO.		5. PROJECT NO.(If applicable) 102716	
6. ISSUED BY CONTRACTING DIVISION USACE, LITTLE ROCK (W9127S) 700 W. CAPITOL AVE, RM 7018 LITTLE ROCK AR 72201-3225		CODE W9127S		7. ADMINISTERED BY (If other than item 6) See Item 6		CODE	
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)				X		9A. AMENDMENT OF SOLICITATION NO. W9127S-05-B-0004	
				X		9B. DATED (SEE ITEM 11) 30-Nov-2004	
						10A. MOD. OF CONTRACT/ORDER NO.	
						10B. DATED (SEE ITEM 13)	
CODE		FACILITY CODE					
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS							
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input checked="" type="checkbox"/> is extended, <input type="checkbox"/> is not extended. Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.							
12. ACCOUNTING AND APPROPRIATION DATA (If required)							
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.							
A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.							
B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).							
C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:							
D. OTHER (Specify type of modification and authority)							
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.							
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) REPLACE VALVE AND OPERATING MECHANISM FOR TAILRACE DRAIN SYSTEM, DARDANELLE POWERHOUSE, YELL COUNTY, ARKANSAS A. Bid opening date and time is hereby set for 22 February 2005 at 2:00 p.m. B. Specification Changes 1. Replace SECTION 05502 w ith revised SECTION 05502, Encl 1. (Continued next page.)							
Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.							
15A. NAME AND TITLE OF SIGNER (Type or print)				16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)			
				TEL: _____ EMAIL: _____			
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)		15C. DATE SIGNED		16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)		16C. DATE SIGNED	

Change is as follows:

Paragraph 2.1, MISCELLANEOUS METALS AND STANDARD METAL ARTICLES. In the table for 'Part 1' Bubbler pipe', change the steel specification from "ASTM A53, galv. A123/A" to "Stainless Steel ASTM A312 Type 304".

2. Replace SECTION 15200 with revised SECTION 15200, Encl 2.

Changes are as follows:

Paragraph 1.3, SUBMITTALS. Under 'Valve and Operator Schedule; G', Change submittal information to read as follows: "A list of valve materials, pressure ratings, operational environment (submersion, solids), valve operator's materials, electrical service, location, source of supply, and reference identification as indicated in the contract drawings. A list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly."

Paragraph 2.4.1, Requirements for Valves. Change Paragraph to read as follows: "Valves shall include electric operator and controls, actuator, handwheel, floor stand, worm and gear operator, operating nut, stem and stem guides, wrench, mechanical open/close position indicator, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Operators, actuators, and accessories shall be factory mounted."

Paragraph 2.4.4.1 General Service Knife Gate Valves. Change paragraph title and paragraph to read as follows:

"2.4.4.1 Knife Gate Valves

Knife gate valves shall conform to the following:

Knife gate valves for this contract shall be bonneted, rated for submersion, greaseless and with appropriate packing. The gate seat will be of the type to prevent the collection of solids. The gate shall have stainless steel bodies with Ni-resistant stainless steel trim or carbon steel bodies. Valves shall meet the requirements of AWWA C500 or AWWA C509 and have Class 150 flanged end connections. Bonnet shall be a NRS Bolted type. Discs shall be knife type of stainless steel construction, and have rising stems. Valves shall be rated for 100-psig service. Valves shall be equipped with handwheel or electrically actuated operators with manual override handwheel."

Add Paragraph as follows:

"2.4.6.2 Valve Stem Guide

The valve stems guide bushings are to be greaseless."

3. Replace SECTION 16415 with revised SECTION 16415, Encl 3.

Changes are as follows:

Paragraph 3.5 MOTORS. Delete the second sentence in its entirety.

C. Drawing Changes:

1. Replace Drawing M-301.2 with Enclosed Drawing M-301.3.
2. Replace Drawing M-302.1 with Enclosed Drawing M-302.2.

Amend 0009, Encl 1

SECTION 05502

METALS: MISCELLANEOUS, STANDARD ARTICLES, SHOP FABRICATED ITEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1	(1992) Carbon Steel Tee Rails
ASTM A 20/A 20M	(1996a) General Requirements for Steel Plates for Pressure Vessels
ASTM A 27/A 27M	(1995) Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 109	(1993) Steel, Strip, Carbon, Cold-Rolled
ASTM A 109M	(1991) Steel, Strip, Carbon, Cold-Rolled (Metric)
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 148/A 148M	(1993b) Steel Castings, High-Strength, for Structural Purposes
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193/A 193M	(1996b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 240/A 240M	(1996) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM A 263	(1994a) Corrosion-Resistant Chromium Steel-Clad Plate, Sheet, and Strip
ASTM A 264	(1994a) Stainless Chromium-Nickel Steel-Clad Plate, Sheet, and Strip
ASTM A 276	(1996) Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A 312/A 312M	(1995a) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 320/A 320M	(1994; R 1995) Alloy Steel Bolting Materials for Low-Temperature Service
ASTM A 325	(1996) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 484/A 484M	(1994b) General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1993) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 502	(1993) Steel Structural Rivets
ASTM A 504	(1993) Wrought Carbon Steel Wheels
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 516/A 516M	(1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 519	(1994) Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A 564/A 564M	(1995) Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

ASTM A 572/A 572M	(1994c) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 618	(1993; R 1995) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(1996) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 730	(1993) Forgings, Carbon and Alloy Steel, for Railway Use
ASTM A 786/A 786M	(1993) Rolled Steel Floor Plates
ASTM B 6	(1995a) Zinc
ASTM B 21	(1996) Naval Brass Rod, Bar, and Shapes
ASTM B 21M (Metric)	(1996) Naval Brass Rod, Bar, and Shapes
ASTM B 23	(1994) White Metal Bearing Alloys (Known Commercially as "Babbitt Metal")
ASTM B 26/B 26M	(1996) Aluminum-Alloy Sand Castings
ASTM B 36/B 36M	(1995) Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B 62	(1993) Composition Bronze or Ounce Metal Casting
ASTM B 121/B 121M	(1995) Leaded Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B 124	(1996) Copper and Copper-Alloy Forging Rod, Bar, and Shapes
ASTM B 124M	(1996) Copper and Copper-Alloy Forging Rod, Bar, and Shapes (Metric)
ASTM B 138	(1996) Manganese Bronze Rod, Bar, and Shapes
ASTM B 138M	(1996) Manganese Bronze Rod, Bar, and Shapes (Metric)
ASTM B 148	(1993a) Aluminum-Bronze Sand Castings
ASTM B 150	(1995a) Aluminum Bronze Rod, Bar, and Shapes
ASTM B 150M	(1995a) Aluminum Bronze Rod, Bar, and Shapes (Metric)

ASTM B 152	(1994) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 152M	(1995) Copper Sheet, Strip, Plate, and Rolled Bar (Metric)
ASTM B 176	(1995) Copper-Alloy Die Castings
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 211	(1995a) Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(1995) Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 241/B 241M	(1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 271	(1996) Copper-Base Alloy Centrifugal Castings
ASTM B 308/B 308M	(1996) Aluminum-Alloy 6061-T6 Standard Structural Shapes
ASTM B 505	(1996) Copper-Base Alloy Continuous Castings
ASTM B 584	(1993b) Copper Alloy Sand Castings for General Applications
ASTM B 749	(1991; R 1991) Lead and Lead Alloy Strip, Sheet, and Plate Products
ASTM B 763	(1996) Copper Alloy Sand Castings for Valve Application
ASTM B 806	(1993a) Copper Alloy Permanent Mold Castings for General Applications
ASTM B 824	(1996) General Requirements for Copper Alloy Castings
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

ASME INTERNATIONAL (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings

ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	(1981; Supple 1991; R 1992) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ASME B18.3	(1986; R 1995) Socket Cap, Shoulder and Set Screws (Inch Series) Including Dimensions of Hexagon and Spline Sockets and Keys to Match
ASME B18.6.1	(1981; R 1991) Wood Screws (Inch Series)
ASME B18.6.2	(1972; R 1993) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.21.1	(1994) Lock Washers (Inch Series)
ASME B18.22.1	(1965; R 1990) Plain Washers
ASME B18.22M	(1981; R 1990) Metric Plain Washers
ASME B27.7	(1977; R 1993) General Purpose Tapered and Reduced Cross-Section Retaining Rings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 1) Shield, Expansion (Shelf Drilling Tubular Expansion Shell Bolt Anchors)
CID A-A-1925	(Rev A; Notice 1) Shield, Expansion (Nail Anchors)
CID A-A-55614	(Rev A) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Rev A) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)
CID A-A-60005	(Rev E; Notice 1) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
FS RR-C-271	(Rev D) Chains and Attachments, Welded and Weldless

FS RR-W-410

(Rev D; Am 1) Wire Rope and Strand

U.S. ARMY CORPS OF ENGINEERS (USACE)

Amend 0003

EM 385-1-1

(2003) U.S. Army Corps of Engineers Safety
and Health Requirements Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531

(1993) Metal Bar Grating Manual

NAAMM MBG 531S

(1989) Guide Specification for Stainless
Steel Grating

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Fabricated Metal Items; G

Detail drawings shall be submitted for approval as specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-03 Product Data

Miscellaneous Metals and Standard Metal Articles; G

Shop Fabricated Metal Items; G

Lists of materials shall be submitted for approval as specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

Records, which identify the disposition of, approved material and fabricated items in the work must be submitted for approval as specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-06 Test Reports

Miscellaneous Metals and Standard Metal Articles; G

Shop Fabricated Metal Items; G

Certified test reports for materials tests and analyses shall be submitted for approval as specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.4 FABRICATION AND WORKMANSHIP REQUIREMENTS

Fabrication requirements and workmanship provisions for items specified in this section shall conform to the requirements of Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

PART 2 PRODUCTS

2.1 MISCELLANEOUS METALS AND STANDARD METAL ARTICLES

Miscellaneous metal materials and standard metal articles shall conform to the respective specifications and other designated requirements. Sizes shall be as specified or shown. Where material requirements are not specified, materials furnished shall be suitable for the intended use and shall be subject to approval.

Part	Steel	Painted	
1-1/2" Valve stem	Schd. 80, weld ends, ASTM A53 grade B, galv. A123/A	Y	
1" Valve stem couplings	XXS (0.358" thick), ASTM A53 grade B, galv. A123/A	N	
7/16" Valve stem pins 3/8" Valve stem shear pins	Stainless steel - A276-00a Type 304 cond S (75ksi yield)	N	
1" Bubbler pipe	Std wt, weld ends, ASTM A53, galv. A123/A <u>Stainless Steel ASTM A312 Type 304</u>	Y	<u>Amend 0009</u>
16" drain pipe	Schd 80, ASTM A53 grade B, galv. A123/A	Y	
Valve Support	<u>Stainless steel - A276-00a Type 304 cond A (30ksi yield)</u>	Y	<u>Amend 0003</u>
Pipe Brackets	ASTM A36 steel Galv. A123/A	Y	
All bolts, nuts, washers	Stainless steel - ANSI type 316	N	
Ladder Expansion Anchors	Stainless steel - ANSI type 316	N	
Ladders, Brackets, and Mounts	<u>Stainless steel - A276-00a Type 304 cond A (30ksi yield)</u>	Y	<u>Amend 0003</u>

See specification 09965 for painting details

2.1.1 Structural Steel

ASTM A 36.

2.1.2 Steel Pipes and Pipe Fittings

2.1.2.1 Pipes

ASTM A 53, Type S, Grade B, seamless, galvanized, nominal size and weight class or outside diameter and nominal wall thickness as shown, plain or threaded (as applicable) ends.

2.1.2.2 Pipe Fittings

- a. Flanged - ASME B16.5 faced and drilled.
- b. Screwed - ASME B16.3.
- c. Butt-welding - ASME B16.9.

2.1.3 Bolts, Nuts, and Washers

Bolts, nuts, and washers shall be of the material, grade, type, class, style and finish indicated or best suited for intended use.

2.1.3.1 Bolts, Nuts, and Washers

- a. Bolts and Nuts - ANSI Type 316, ASTM 276-00a Type 304 cond S (75ksi yield).
- b. Bolts - ASME B18.2.1.
- c. Nuts - ASME B18.2.2.
- d. Washers
 - (1) Plain Washers - ASME B18.22.1, Type B.
 - (2) Lock Washer - ASME B18.21.1.
 - (3) Beveled Washers - ASTM F 436, Beveled.

2.1.4 Screws

Screws shall be of the material, grade, type, style, and finish indicated or best suited for use intended.

2.1.4.1 Cap Screws

ASME B18.2.1, ASME B18.3, or ASME B18.6.2 as required.

2.1.4.2 Machine Screws

ASME B18.6.3.

2.1.4.3 Set Screws

ASME B18.6.2.

2.1.5 Expansion Anchors

Type as required, except that nail driven types will not be acceptable, stainless steel unless otherwise indicated.

2.2 SHOP FABRICATED METAL ITEMS

Shop fabricated metal items shall conform to the requirements and details as specified or shown and to the workmanship provisions and other applicable fabrication requirements as specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.2.1 Ladders

Ladders shall be fixed-rail metal ladders conforming to the requirements of EM 385-1-1 and to details shown.

2.2.1.1 Ladder Materials and Dimensions

Amend 0003

Ladders shall be fabricated of ~~structural stainless~~ steel as shown ~~and shall be galvanized after fabrication in conformance with ASTM A 123/A 123M~~. Fabrication of ladders shall consist of solid-section rod rungs, with non-slip surfaces, fitted into holes in bar side rails and welded. Splices in side rails shall be made using full penetration welds and shall provide a flush and smooth transition between connecting ends. All welds shall be ground smooth. Ladders shall not be less than 16 inches in width, with 1-inch diameter rungs, spaced 12 inches apart. The two stringers shall be a minimum 1/2-inch thick and 2-1/2 inches wide.

2.2.1.2 Bracket Materials and Dimensions

Ladder rails shall be welded to bent-bar supporting brackets anchored to supporting structure as shown. All welds shall be ground smooth. Brackets will provide the installed ladder with at least 6 inches of space between the wall and rungs

2.2.1.3 Anchor Materials and Dimensions

Amend 0003

Ladders shall be adequately anchored to the wall by means of ~~galvanized stainless~~ steel bolt expansion anchors spaced not more than 6 feet apart vertically. Anchors shall be 3/4" in diameter with a minimum embedment depth of 4-3/4".

2.2.1.4 Rigid Rail Ladder Safety Device

Ladders installed in this contract shall be equipped with a rigid rail fall prevention system such as Saf-T-Climb by North Safety Products or an approved equivalent. Material shall be hot-dipped galvanized after fabrication. The system shall be installed per manufacturers guidelines and meet OSHA s1910.27 and s1926.1053.

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

Amend 0009, Encl 2

SECTION 15200

PIPELINES, LIQUID PROCESS PIPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 126	(1995) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 182/A 182M	(1997c) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193/A 193M	(1998) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1998) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 268	(1996) Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 312/A 312M	(1995a) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 351/A 351M	(1994a) Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 395	(1988; R 1998) Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 403/A 403M	(1998) Wrought Austenitic Stainless Steel Piping Fittings

ASTM A 513	(1997) Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 576	(1990b; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 813/A 813M	(1995) Single- or Double-Welded Austenitic Stainless Steel Pipe
ASTM A 815/A 815M	(1998) Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A 858/A 858M	(1996) Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service
ASTM A 865	(1997) Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1996; B16a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.28	(1994) Wrought Steel Buttwelding Short Radius Elbows and Returns
ASME B31.1	(1998) Power Piping
ASME B31.3	(1999) Process Piping
ASME B36.19M	(19685; R 1994) Stainless Steel Pipe
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C508	(1993; C508a) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(1994) Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(1990) Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
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CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-89	(1998) Pipe Hangers and Supports - Fabrication and Installation Practices

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemical Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids

1.2 SYSTEM DESCRIPTION

This specification covers the requirements for above grade liquid process pipe, pipe supports, fittings, equipment and accessories located both inside and outside of treatment plants.

1.2.1 Design Requirements

Support systems shall be selected and designed within the specified spans and component requirements. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing supports.

1.2.2 Performance Requirements

The pressure ratings and materials specified represent minimum acceptable standards for piping systems. The piping systems shall be suitable for the services specified and intended. Each piping system shall be coordinated to function as a unit. Flanges, valves, fittings and appurtenances shall have a pressure rating no less than that required for the system in which they are installed.

1.2.2.1 Above Grade Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as support spans and ambient temperatures. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Pipe and Equipment; G,

Equipment shop drawings and support system detail drawings showing piping systems and appurtenances, such as mechanical joints, valves, local indicators and hangers, including a complete list of equipment and materials. As-built drawings showing pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. As-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, drains, and all other inline devices; if the contract drawings contained P&IDs, the P&IDs found in the contract drawings shall be revised to reflect the constructed process system, as directed by the Contracting Officer.

SD-03 Product Data
Qualifications;

A statement certifying that the Contractor has the specified experience.

Welders;

The names of all qualified welders, their identifying symbols, and the qualifying procedures for each welder including support data such as test procedures used, standards tested to, etc.

Assistance and Training;

A signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

Delivery, Storage and Handling;

Material safety data sheets;

Materials and Equipment;

Manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings; thermal characteristics (coefficient of expansion and thermal conductivity); and chemical resistance to each chemical and chemical mixture in the liquid stream.

Installation;

The manufacturer's installation recommendations or instructions for each material or procedure to be utilized, including materials preparation.

Pipe Schedule;

A list of piping systems, pressure ratings and source of supply for each piping system broken out by material, size and application as indicated on the contract drawings. A list of any special tools necessary for each piping system and appurtenances furnished for adjustment, operation, maintenance and disassembly of the system.

Valve and Operator Schedule; G

A list of valve materials, pressure ratings, operational environment (submersion, solids), valve operator's materials, air supply pressure, electrical service, location, source of supply, and reference identification as indicated in the contract drawings. A list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly.

Amend 0009

SD-06 Test Reports

Pipe Leakage Tests; Hydrostatic Tests; Valve Testing;

Copies of all field test reports within 24 hours of the completion of the test.

SD-10 Operation and Maintenance Data

Piping, Valves, and Appurtenances;

Six copies each of operation and maintenance manuals in indexed booklet form. Operation manuals shall detail the step-by-step procedures required for specialized startup, operation and shutdown of piping systems, and shall include the manufacturer's name, model number, parts list and brief description of piping equipment such as valves and other appurtenances and their basic operating features. Maintenance manuals shall list routine maintenance procedures and troubleshooting guides for the equipment, and shall include piping layout and valve locations.

1.4 QUALIFICATIONS

1.4.1 Contractor

Contractor shall have successfully completed at least 3 projects of the same scope and size or larger within the last 6 years. Contractor shall demonstrate specific experience in regard to the system installation to be performed.

1.4.2 Welders

The welding of pressure piping systems shall be in accordance with qualifying procedures using performance qualified welders and operators. Procedures and welders shall be qualified in accordance with Section 05093 WELDING PRESSURE PIPING.

1.5 GENERAL JOB REQUIREMENTS

Piping materials and appurtenances shall be as specified and as shown on the drawings, and shall be suitable for the service intended. Piping materials, appurtenances and equipment supplied as part of this contract shall be new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems are indicated by service in the contract drawings.

1.5.1 Components

Piping equipment and appurtenances shall be new products of equal material and ratings as the connecting pipe.

1.5.2 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturing of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Nominal sizes for

standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.5.3 Identification

Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. Valves shall bear a securely attached tag with the manufacturer's name, valve model number, and valve identification permanently displayed and be marked in accordance with MSS SP-25.

1.6 DELIVERY, STORAGE AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Environmental Requirements

Piping system design, supply and installation shall address the external corrosion conditions so indicated.

1.7.2 Existing Conditions

The Contractor shall be responsible for the verification of existing piping and penetrations. Prior to ordering materials, the Contractor shall verify the size, material, joint types, elevation, horizontal location, and pipe service of existing pipes, and inspect size and location of structure penetrations to verify adequacy of wall sleeves, and other openings before installing connecting pipes.

1.7.3 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.8 MAINTENANCE

1.8.1 Service

Services for valve systems shall be provided by a manufacturer's representative who is experienced in the installation, adjustment and operation of the equipment specified. The representative shall inspect the installation, and supervise the adjustment and testing of the equipment.

1.8.2 Extra Materials

Concurrent with delivery and installation of the specified piping systems and appurtenances, spare parts for each different item of material and equipment specified that is recommended by the manufacturer to be replaced any time up to 3 years of service shall be furnished. For each type and size of valve, the following extra materials shall be provided: lubricator, lubricant (with appropriate temperature rating), lubricator/isolating valve; galvanized operating wrench, 4.1 feet long, for T-handled operators. Extra materials shall include 2 of the following spare parts for each type and size of valve: gaskets; O-ring seals; all elastomer parts; and stem packing.

PART 2 PRODUCTS

2.1 CARBON STEEL PIPING SYSTEM

2.1.1 Carbon Steel Pipe

2.1.1.1 General Service

Unless specified otherwise, carbon steel pipe shall meet the requirements of ASTM A 53 seamless, Grade A or API Spec 5L, Schedule 40.

2.1.2 Carbon Steel Joints

Carbon steel piping shall be joined by welding fittings or flanges meeting the requirements of AWWA C606. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.1.3 Carbon Steel Fittings

Fittings shall be cast malleable iron or carbon steel. Where cast fittings are not available, segmental welded steel fittings, ASTM A 53, Grade B, meeting the requirements of manufacturer's recommended wall thickness shall be fabricated.

2.1.3.1 Threaded Fittings

Amend 0003

~~Threaded fittings are not called for on this project. shall be Class 150, forged carbon steel ASTM A 105/A 105M, conforming to ASME B16.11, low carbon steel, ASTM A 858/A 858M, conforming to ASME B16.11, and threaded in accordance with ASME B1.20.1. Threaded, rigid couplings shall be seamless, black carbon steel in accordance with ASTM A 865 and threaded in accordance with ASME B1.20.1.~~

2.1.3.2 Welding Fittings

Welding fittings shall be butt-welding or socket-welding. Welding fittings shall be forged steel, ASTM A 105/A 105M Class 150 conforming to ASME B16.9 and ASME B16.28, or ASME B16.11.

2.1.3.3 Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the same as that of the associated pipe. The flanges shall be welding neck, socket welding, or lapped type. Flanges and flanged fittings shall be forged steel, ASTM A 105/A 105M, faced and drilled to ASME B16.5 Class 150 with a 0.0625 inch raised face. For tie-in to existing flanges, the Contractor shall field check existing flanges for non-standard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolting shall be alloy-steel ASTM A 193/A 193M Grade B5 or B7 hex head bolts and ASTM A 194/A 194M Grade 3 or 8N hex head nuts. When mating flange on valves or equipment is cast iron, ASTM A 193/A 193M Grade B8 Class 1 bolts and ASTM A 194/A 194M Grade 8 heavy hex head nuts shall be used. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Nonmetallic gaskets shall conform to ASME B16.21 and be a maximum 0.125 in. thick chloroprene rubber, durometer hardness No.80, 1,500-psi minimum tensile strength, 125 percent minimum elongation, flat ring type for use with raised face flanges.

2.4 VALVES

2.4.1 Requirements For Valves

Amend 0003

Valves shall include electric operator and controls, actuator, handwheel, floor stand, worm and gear operator, operating nut, stem and stem guides, wrench, mechanical open/close position indicator, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Operators, actuators, and accessories shall be factory mounted.

Amend 0009

2.4.2 Valve Schedule

Requirements relative to this paragraph are shown on the contract drawings.

2.4.3 Factory Finishing

Valves shall have an epoxy lining and coating in accordance with AWWA C550 unless otherwise specified. The epoxy shall be either a two-part liquid material or a heat-activated (fusion) material except that only a heat-activated material shall apply if a valve coating is specified as "fusion" or "fusion bonded" epoxy. The epoxy lining and coating shall have a minimum (7.0 mils) dry film thickness except where it is limited by valve operating tolerances. Exposed valves shall be finished in accordance with Section 65 PAINTING, GENERAL.

2.4.4 Knife Gate Valves

Amend 0003

2.4.4.1 ~~General Service Knife~~ Gate Valves

~~General service Knife~~ gate valves shall conform to the following:

Amend 0009

Knife gGate valves for this contract shall be bonneted, rated for submersion, greaseless and with appropriate packing. The gate seat will be of the type to prevent the collection of solids. The gate , 2.5 inches and larger, shall have stainless steel bodies with Ni-resistant stainless steel trim or carbon steel bodies. Valves shall meet the requirements of AWWA C500 or AWWA C509 and have Class 150 flanged end connections. Bonnet shall be a NRS Bolted type. Discs shall be knife type of stainless steel construction, and have rising stems. Valves shall be rated for 100-psig service. Valves shall be equipped with handwheel or electrically actuated operators with manual override handwheel.

2.4.5 Operators

2.4.5.1 Operator Schedule

Requirements relative to this paragraph are shown on the contract drawings.

2.4.5.2 Manual Operator

Amend 0006

All operators are to be electric with manual override. Specification for the manual override operators is provided in paragraph 2.4.5.3.

2.4.5.3 Electric Operator

Electric operators shall be provided complete with actuators, local push button station, three buttons (OPEN STOP CLOSE) two lights (GREEN for local and RED for Remote) and three-position selector switch (LOCAL OFF REMOTE), local position indicator potentiometer and accessories. The actuators shall operate on 460 VAC, 3PH with a 75 percent duty cycle and shall be equipped with an AC thermal overload protector with automatic reset, reversing (bi-directional) operation for use with quarter-turn valves, or rotating equipment to full rotation. Gearing shall be a two-stage planetary, permanently lubricated self-locking gear train with self-lubricating bearings; connections via male output shaft. The start-up torque shall be 120 foot-pound. The stall torque shall be 150 foot-pound. Two travel stop limit switches with cams, internal, independent, adjustable, and actuated by cams shall be mounted on the drive shaft. A side mounted hand turn wheel shall be provided for a manual override. The force in the manual operator shall not exceed 39.3 pound under any operating condition, including initial breakaway. The manual operator shall be a self-locking type or shall be equipped with a self-locking device. The actuators shall have a NEMA 250 Type 4 enclosure with a corrosion resistant, baked epoxy finish as standard. The actuator shall operate in a temperature range of -40 to 150 degrees F. Actuators shall fail in last position unless otherwise indicated. Electric operators shall be furnished with features noted. Limit switches shall be provided on all actuators. Electric valve operator shall be Limitorque model L120

Amend 0006

or approved equal. In addition, operator shall be provided with mounting adaptation to fit existing floor mount manufactured by Crane.

Exposed Operators. Exposed operators shall have galvanized and painted handwheels. Wheels shall be lockable with a chain and padlock.

Amend 0006

- a. Limit Switches. Limit switches shall be single-pole, double-throw (SPDT) type, rated 10 amps at 120 volts ac, housed in a NEMA 250 Type 4 enclosure, and adjustable for open and closed valve positions.
- b. Positioners. The positioners for modulating actuators shall control valve positions as a function of the input signals. Position indicator shall be a potentiometer. Corrosion-resistant enclosures for positioners shall be splash-and moisture-proof with gasketed covers.

2.4.6 Valve Accessories

2.4.6.1 Tagging

Identification tags made of stamped stainless steel indicating service and valve number shown on the contract drawings shall be installed on valves using No. 12 AWG copper wire, stainless steel wire, or chrome-plated beaded chain. Tags shall be 1.375-inch minimum diameter. Indentations shall be black for reading clarity.

2.4.6.2 Valve Stem Guide

Amend 0009

The valve stems guide bushings are to be greaseless.

2.5 MISCELLANEOUS PIPING COMPONENTS

2.5.1 Indicating Devices

2.5.1 Expansion Joints

The Contractor shall provide all structural work and equipment required to control expansion and contraction of piping. The Contractor shall verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems.

2.5.1.1 Expansion Joint for Metallic Pipe

The expansion joint shall be a single slip type with stainless steel wetted materials of construction. The expansion joint shall be sized to match the associated piping. The maximum allowable working pressure shall be 150 psig at 120 degrees F. The expansion joint shall be sized for a maximum axial compressing deflection of 3 inches, a lateral movement of 0.5 inches and an angular rotation of 15 degrees. End connections shall be as specified for the associated pipe joints. Required accessories for a complete assembly shall be provided.

2.6 PIPE SUPPORTS AND PENETRATIONS

Auxiliary steel shall be provided by the Contractor where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor shall have the option to use pre-engineered support systems of stainless steel products. However, a mixture of support system manufacturers products is not permitted.

2.6.1 Pipe Supports

Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69, and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither shall have a deteriorating action on the other.

2.6.1.1 Brackets

Where piping is run adjacent to walls or steel columns, the Contractor shall provide welded brackets, pre-punched with a minimum of two fastener holes.

2.6.1.2 Offset Pipe Clamp

Where pipes are indicated as offset from wall surfaces, a double-leg design two-piece pipe clamp shall be supplied by the Contractor.

2.6.2 Pipe Guides

For piping, alignment guides shall be galvanized steel or stainless steel, roller type guides.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage.

3.1.2 System Preparation

3.1.2.1 Pipe and Fittings

Pipe and fittings shall be inspected before exposed piping is installed. The Contractor shall clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.1.2.2 Damaged Coatings

The Contractor shall repair damaged coating areas in the field with material equal to the original coating. The Contractor shall not install damaged piping materials.

3.1.2.3 Field Fabrication

The Contractor shall notify the Contracting Officer at least 2 weeks prior to the field fabrication of pipe or fittings and at least 3 days prior to the start of any surface preparation or coating application work. Field welding shall be performed in accordance with Section 05093 WELDING PRESSURE PIPING. Welding electrodes shall be provided in accordance with Table 4.1 of AWS D1.1 as required for the applicable base metals and welding process. Fabrication of fittings shall be performed in accordance with the manufacturer's instructions.

3.2 EXPOSED PIPING INSTALLATION

Exposed piping shall be run as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

3.2.1 Anchors and Fasteners

Impact expansion (hammer and explosive charge drive-type) anchors and fastener systems are not acceptable. Lead shields, plastic or fiber inserts, and drilled-in plastic sleeve/nail drive systems are also not acceptable.

3.2.1.1 Drilled-In Expansion Anchors and Fasteners

Anchors shall be designed to accept both machine bolts and/or threaded rods. Such anchors shall consist of an expansion shield and expander nut contained inside the shield. The expander nut shall be fabricated and designed to climb the bolt or rod thread and simultaneously expand the shield as soon as the threaded item, while being tightened, reaches, and bears against the shield bottom. The shield body shall consist of four legs; the inside of each shall be tapered toward shield bottom (or nut end). The end of one leg shall be elongated and turned across shield bottom. The outer surface of shield body shall be ribbed for grip-action. The expander nut shall be of square design with sides tapered inward from bottom to top. The anchor materials of construction shall be TP304 stainless steel of 43,541-psi minimum tensile strength. Fasteners shall be machine bolts for use with above anchors; nuts and washers shall conform to ASTM A 194/A 194M. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The anchor/fastener assembly shall be UL listed with a one-piece stud (bolt) that has integral expansion wedges, nuts and washers. The stud shall be constructed of TP304 stainless steel, and nut and washer of TP304 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application.

3.2.2 Piping Expansion Provisions

The piping shall be installed to allow for thermal expansion resulting from the difference between installations and operating temperatures. Anchors shall be installed as shown in the contract drawings to withstand expansion thrust loads and to direct and control thermal

expansion. An intermediate pipe guide shall be installed for every pipe at each metal channel framing support not carrying an anchor or alignment guide. Where pipe expansion joints are required, pipe alignment guides shall be installed adjacent to the expansion device and within four pipe diameters. Expansion devices shall be installed in accordance with the manufacturer's instructions and at the locations shown in the contract drawings.

3.2.3 Piping Flexibility Provisions

Flexible couplings and expansion joints shall be installed at connections to equipment, and where shown on the contract drawings. Additional pipe anchors and flexible couplings beyond those shown on the contract drawings shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

3.2.4 Couplings, Adapters and Service Saddles

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3.2.5 Piping Equipment/Component Installation

Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable installation.

3.2.5.1 Local Indicators

All direct-reading indicator devices and pressure gauges shall be installed so that they can be easily read from floor level, and are readily accessible for maintenance and service. Pressure gauges shall be installed where indicated in the contract drawings. Field calibration of all indicators shall be performed at time of installation to ensure measuring and reading accuracy.

3.2.6 Pipe Flanges

Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

3.2.7 Valve Locations

Valves shall be located in accordance with the contract drawings where actuators are shown.

3.2.8 Pipe Tap Connections

Taps to pipe barrels are unacceptable. Taps to steel piping shall be made only with a welded threadolet connection.

3.3 EXTERNAL CORROSION PROTECTION

Protect all pipe and piping accessories from corrosion and adverse environmental conditions.

3.3.1. Ferrous Piping

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, mill scale or other foreign substances shall be mechanically cleaned by power wire brushing and primed with a ferrous metal primer. Primed surfaces shall be finished in accordance with Section 09965 PAINTING, HYDRAULIC STRUCTURES.

3.5 FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Flexible joints shall be provided at the face of all structures, whether or not shown on the contract drawings. Mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints shall be considered flexible joints; welded pipe joints shall not. Joints may be flush with the structure face or may be located up to 1 pipe diameter away from face, but not further than 17.7 inches away from face.

3.6 CLOSURES

Closure pieces shall be installed as necessary to end pipe runs and shall conform to ASME B16.9 or ASME B16.11. Elastomer sleeves bonded to pipe ends are not acceptable. Pressure piping shall have closures of blind flanges or plain end pieces, with thickness matching the nominal wall thickness of the associated pipe, mounted on double flexible couplings, unless otherwise shown on contract drawings or approved by the Contracting Officer.

3.7 VALVE INSTALLATION

Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly.

3.7.1 Valve Orientation

The operating stem of a manual valve shall be installed in a vertical position.

3.8 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the contract drawings shall not relieve the Contractor of responsibility for sizing and providing supports.

3.8.1 General Support Requirements

Pipe support systems shall meet the requirements of MSS SP-58. Contractor-designed and selected support systems shall be installed in accordance with MSS SP-69, and as specified herein. Piping connections to equipment shall be supported by pipe supports and not off the equipment. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Pipe supports and hangers shall not be installed in equipment access areas. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration. Lateral supports shall be installed at all changes in direction.

3.8.2 Support Methods

Piping support shall be provided as specified and as shown in the contract drawings. Vertical piping shall be supported by wall brackets, base elbows, or riser clamps on floor penetrations.

3.9 FIELD QUALITY CONTROL

3.9.1 Pipe Leakage Tests

Unless approved by the Contracting Officer, leakage testing shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the piping shall be subjected to not less than 100 psig pressure. Leakage is defined as the quantity of the test liquid, water, that is supplied to the piping system, or any valved or approved section thereof, in order to maintain pressure within 5 psi of the specified leakage test pressure after the piping has been filled with the test liquid and all air is expelled. No piping installation will be accepted if leakage exceeds the allowable leakage determined by the following formula:

$$L = C_f \times N \times D \times P^{0.5}$$

C_f = conversion factor = 0.0001351
 L = allowable leakage, gallons per hour
 N = number of joints in the length of piping tested
 D = nominal pipe diameter, inches
 P = average test pressure during the test, psig.

Should any test disclose leakage greater than that allowed, the leaks shall be located and repaired until the leakage is within the specified allowance, without additional cost.

3.9.2 Testing New to Existing Connections

New piping connected to existing pipe and existing equipment shall be tested. The Contractor shall isolate the new piping with pipe caps, spectacle blinds, or blind flanges. The joint between new piping and existing piping shall be tested by methods that do not place the entire existing system under the test load. The Contractor shall then proceed with the testing of new piping systems as specified herein.

3.9.3 Valve Testing

Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. The Contractor shall count and record the number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data.

3.10 FINAL CLEANING

3.10.1 Interim Cleaning

The Contractor shall prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. The piping shall be examined to assure removal of these and other foreign objects prior to assembly and installation.

-- End of Section --

Amend 0009, Encl 3

SECTION 16415

ELECTRICAL WORK, INTERIOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.16	(2000) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C57.12.70	(1978; R 1993) Terminal Markings and Connections for Distribution and Power Transformers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D 709	(2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C57.13	(1993) Instrument Transformers
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1004	(1994; Rev thru Nov 1999) Electric Motors
UL 1010	(1995; Rev thru Mar 1999) Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1449	(1996; Rev thru Dec 1999) Transient Voltage Surge Suppressors
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection Use
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 44	(1999) Thermoset-Insulated Wires and Cables

UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 508	(1999) Industrial Control Equipment
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the equipment shall be properly located and readily accessible. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of

the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch
High Letters

Minimum 1/8 inch
High Letters

Panelboards

Control Devices

Junction box

Valve actuator operating mechanism

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings Interior Electrical Equipment; G.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

- a. Panel boards
- b. Valve actuator operating mechanism
- c. Existing pump control distribution panel
- d. Conduit system
- e. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.
- f. Sway bracing for suspended conduit.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces

shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

SD-03 Product Data
Manufacturer's Catalog;

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents. Manufacturer's catalog shall include valve actuator operating mechanism and panelboard.

Material and Equipment, Lists;

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures;

Installation procedures for rotating equipment, valve operating mechanism. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings; G,

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, wire labels, control diagram, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the

Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G,

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G,

Six copies of the information described below in 216 x 280 mm (8 1/2 x 11 inch) binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

SD-07 Certificates

Materials and Equipment;

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items, which are required to be listed and labeled in accordance with Underwriters Laboratories, must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. [All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 Aluminum Conductors

Aluminum conductors shall not be used

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83 except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83.

2.1.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.5 Mineral-Insulated, Metal-Sheathed Cable

UL listed NFPA 70, type MI cable. Sheathing containing asbestos fibers shall not be used.

2.2 CIRCUIT BREAKERS

2.2.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489 and UL 877 for circuit breakers and circuit breaker enclosures located in hazardous

(classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.2.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper and aluminum conductors in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible. Series rated breakers are not acceptable.

2.2.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1.

2.2.1.3 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.3 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.3.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall

have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.3.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 0	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.4 CONDUIT AND TUBING

2.4.1 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.4.2 Electrical Metallic Tubing

UL 797

2.4.3 Rigid Metal Conduit

UL 6.

2.5 CONDUIT AND DEVICE BOXES AND FITTINGS

2.5.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.5.2 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.5.3 Fittings for Conduit and Outlet Boxes

UL 514B.

2.6 CONNECTORS, WIRE PRESSURE

2.6.1 For Use With Copper Conductors

UL 486A.

2.7 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.7.1 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.8 ENCLOSURES

NEMA ICS 6 or NEMA 250 unless otherwise specified.

2.8.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.8.2 Circuit Breaker Enclosures

UL 489.

2.8.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 877.

2.9 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors. In addition to the standards listed above, motors shall be provided with efficiencies as specified in the table "MINIMUM NOMINAL EFFICIENCIES" below.

2.9.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.9.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors. Applications, which require definite purpose, special purpose, special frame, or special mounted polyphase induction motors, are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4
250	95.4	96.2	95.8
300	95.4	95.0	95.4
350	94.5	95.4	95.0
400	94.1	95.8	95.0
450	94.5	95.4	95.4
500	94.5	94.5	94.5

2.10 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.10.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845.

2.10.2 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.10.3 Low-Voltage Motor Overload Relays

2.10.3.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds.

2.10.3.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dashpot mounted on a common frame.

2.10.3.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.10.4 Automatic Control Devices

2.10.4.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.10.4.2 Local/Remote Selection

- a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked LOCAL-OFF-REMOTE) shall be provided for the manual control.
- b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked LOCAL-OFF-REMOTE.
- c. Connections to the selector switch shall be such that; only the normal remote regulatory control devices will be bypassed when the switch is in the local position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the remote and the local positions of the selector switch. Control circuit connections to any LOCAL-OFF-

REMOTE switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.11 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.12 TAPES

2.12.1 Plastic Tape

UL 510.

2.12.2 Rubber Tape

UL 510.

2.13 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in electrical metallic tubing (EMT) conduit and liquid tight flexible conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in

Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding. .

3.2.1.2 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.3 Supports

Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways

shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.4 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.5 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

3.2.2 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.2.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.2.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.2.3 Not Used

3.2.2.4 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

3.2.2.5 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

- a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
120/240-volt, 1-phase: Black and red.

- b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.
- c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total

combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 1. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets, which depend on gypsum wallboard or plasterboard for primary support, will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate

boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

3.4.1 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings

3.5 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. ~~Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts.~~ Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

Amend 0009

3.6 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches

specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the remote-control device does not have such a rating, a magnetic starter shall be used, with the remote-control device actuating the pilot-control circuit. When combination local and remote control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked LOCAL-OFF- REMOTE. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any LOCAL-OFF- REMOTE switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.6.1 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.6.2 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.7 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.8 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 2 m (6 feet) or less in

length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.8.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.9 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.10 PAINTING AND FINISHING

Field-applied paint on exposed conduits shall be provided. Paint shall be matched existing wall and ceiling paint color and shall be in accordance to section 09965- PAINTING.

3.11 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.12 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests, which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.12.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment, which are damaged due to improper test procedures or handling.

3.13 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.14 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --